

**CLAIMS**

1. An exhaust gas sensor control device for an exhaust gas sensor that is mounted in an exhaust path of an internal combustion engine, wherein said exhaust gas sensor includes  
5 a sensor element that becomes active when an activity temperature is reached, the exhaust gas sensor control device comprising:

an impedance detection device for detecting an  
10 element impedance of said sensor element;

an impedance judgment device for judging whether said element impedance is lowered to an activity judgment value;

a received heat amount estimation device for estimating the amount of heat received by said sensor  
15 element;

a heat amount judgment device for judging whether an activity judgment heat amount is reached by said amount of heat received; and

an activity judgment device for formulating an  
20 activity judgment of said exhaust gas sensor when an affirmative judgment is executed either by said impedance judgment device or by said heat amount judgment device.

2. The exhaust gas sensor control device according  
25 to claim 1, wherein said exhaust gas sensor includes a heater for heating the sensor element;

said exhaust gas sensor control device further comprising a heater drive device for driving said heater in an environment where the activation of said exhaust gas sensor is demanded;

5            wherein said heat amount judgment device determines whether an activity judgment heat amount is reached by the amount of heat received by said sensor element based on the result of whether an activity judgment time is reached by a period of time during which the heater is powered after  
10 the activation of said exhaust gas sensor is demanded.

3. The exhaust gas sensor control device according to claim 1, wherein said exhaust gas sensor includes a heater for heating the sensor element;

15            said exhaust gas sensor control device further comprises a heater drive device for driving said heater in an environment where the activity of said exhaust gas sensor is demanded;

             wherein said heat amount judgment device determines  
20 whether an activity judgment heat amount is reached by the amount of heat received by said sensor element based on the result of whether an activity judgment power supply amount cumulative value is reached by the cumulative amount of power that has been supplied to the heater after the activity of  
25 said exhaust gas sensor is demanded.

4. The exhaust gas sensor control device according to claim 1, wherein said heat amount judgment device determines whether an activity judgment heat amount is reached by the amount of heat received by said sensor element  
5 based on the result of whether an activity judgment air amount is reached by the cumulative amount of air that has been taken in after internal combustion engine startup.

5. The exhaust gas sensor control device according  
10 to claim 1, wherein said heat amount judgment device determines whether an activity judgment heat amount is reached by the amount of heat received by said sensor element based on the result of whether an activity judgment fuel amount is reached by the cumulative amount of fuel that has  
15 been supplied to an internal combustion engine after internal combustion engine startup.

6. The exhaust gas sensor control device according to any one of claims 1 to 5, further comprising:

20 a startup water temperature detection device for detecting a startup cooling water temperature of an internal combustion engine,

wherein said heat amount judgment device includes an activity judgment heat amount setup device for increasing  
25 said activity judgment heat amount with a decrease in said startup cooling water temperature.

7. The exhaust gas sensor control device according to any one of claims 1 to 6, wherein said exhaust gas sensor includes a heater for heating the sensor element,

5       said exhaust gas sensor control device further comprising

      a heater drive device for driving said heater in an environment where the activity of said exhaust gas sensor is demanded; and

10       a battery voltage detection device for detecting a battery voltage;

      wherein said received heat amount estimation device includes a warm-up period correlation value calculation device for detecting a warm-up period correlation value that  
15       correlates with a warm-up period for said sensor element; and wherein said heat amount judgment device includes a device for judging, when a sensor activity judgment correlation value is reached by said warm-up period correlation value, that said activity judgment heat amount  
20       is reached by said amount of heat received, and a judgment value setup device for increasing said sensor activity judgment correlation value with a decrease in a battery voltage prevailing during a warm-up process for said sensor element.

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8. The exhaust gas sensor control device according

to any one of claims 1 to 7, wherein said exhaust gas sensor includes a heater for heating said sensor element,

said exhaust gas sensor control device further comprising;

5 a heater drive device for driving said heater in an environment where the activity of said exhaust gas sensor is demanded, said heater drive device including a feedback control device for exercising feedback control over said heater so that said element impedance coincides with target  
10 impedance;

a deterioration judgment device for judging the deterioration of the sensor element when said element impedance is judged to be excessive for the amount of heat received by said sensor element; and

15 a target impedance correction device for increasing the target impedance for correction purposes when said sensor element is judged to have deteriorated.

9. The exhaust gas sensor control device according  
20 to any one of claims 1 to 8, wherein said exhaust gas sensor includes a heater for heating said sensor element,

said exhaust gas sensor control device further comprising;

a heater drive device for driving said heater in an  
25 environment where the activity of said exhaust gas sensor is demanded, said heater drive device including a feedback

control device for exercising feedback control over said heater so that said element impedance coincides with target impedance;

5 a deterioration judgment device for judging the deterioration of the sensor element when said element impedance is judged to be excessive for the amount of heat received by said sensor element; and

10 an activity judgment value correction device for increasing said activity judgment value for correction purposes when said sensor element is judged to have deteriorated.

10. The exhaust gas sensor control device according to claim 8 or 9, wherein the condition to be judged by said impedance judgment device and the condition to be judged by said received heat amount estimation device are predefined so that the former condition is satisfied prior to the latter condition when said sensor element exhibits an initial impedance; and wherein said deterioration judgment device judges that said element impedance is excessive for said amount of heat received when the latter condition is satisfied prior to the former condition.

25 11. An exhaust gas sensor control device for an exhaust gas sensor that is mounted in an exhaust path of an internal combustion engine, wherein said exhaust gas

sensor includes a sensor element that becomes active when an activity temperature is reached, the exhaust gas sensor control device comprising:

5 impedance detection means for detecting an element impedance of said sensor element;

impedance judgment means for judging whether said element impedance is lowered to an activity judgment value;

received heat amount estimation means for estimating the amount of heat received by said sensor element;

10 heat amount judgment means for judging whether an activity judgment heat amount is reached by said amount of heat received; and

activity judgment means for formulating an activity judgment of said exhaust gas sensor when an affirmative  
15 judgment is executed either by said impedance judgment means or by said heat amount judgment means.